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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/812,868	03/31/2004	Teruyoshi Washizawa	00862.023527	4554

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EXAMINER	
THORNEWELL, KIMBERLY A	
ART UNIT	PAPER NUMBER
2128	

DATE MAILED: 07/21/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/812,868	WASHIZAWA, TERUYOSHI
	Examiner	Art Unit
	Kimberly Thornewell	2128

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 March 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-14* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-14* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *3/31/2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *5/26/2004*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-14 are pending in the instant application.

Priority

2. Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119(a)-(d).

Information Disclosure Statement

3. The information disclosure statement (IDS) submitted on 5/26/2004 is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Claim Interpretation

4. The term "existence ratio" has not been defined in the Applicant's disclosure. Accordingly, the term has been interpreted to mean a density value.

Claim Rejections - 35 USC § 101

5. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

6. Claims 1-6 and 13-14 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

Independent claims 1 and 4 are directed to ideas that are abstract in nature in that they lack a tangible result. Both methods result in obtaining a solution of a structure optimal designing problem. However, once obtained, the solution resulting from the methods is not stored or made available for use through a form of conveyance. Dependent claims 2, 3, 5 and 6 do not overcome the rejection because they also do not involve performing an action on the obtained solution. Rather, the dependent claims clarify how the processes used to obtain the solution are executed.

Claims 13 and 14 are directed to software, per se. The claims are directed to a program that is executed by an apparatus and the claimed modules within the program can be interpreted as mere code. Furthermore, the program has not been stored in a tangible embodiment.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

8. Claims 1, 2, 7, 8, and 13 are rejected under 35 U.S.C. 102(b) as being anticipated by Patnaik et al, "Merits and Limitations of Optimality Criteria Method for Structural Optimization, NASA Technical Paper 3373, 1993.

Claims 1, 7 and 13 are directed to a method for, an information processing apparatus for, and program to be executed by an information processing apparatus for, respectively, optimally designing a structure comprising a step of obtaining a solution of a structure optimal designing problem, formulated as a dual optimization problem having ***a first solution process*** to solve an optimization problem of a first evaluation functional for ***a status variable vector and a design variable vector*** and a ***second solution process*** to solve an optimization problem of a second evaluation functional ***for said status variable vector and said design variable vector***, wherein when ***said status variable vector is a displacement in each node, and said design variable vector is an existence ratio of a structural member in each element***, said ***first solution process including said second solution process as one step***, and further including ***a design variable update step*** of ***reading*** said design variable vector and said status variable vector stored in a first storage unit, ***updating*** said design variable vector, and ***storing*** the updated design variable vector into said first storage unit, and said ***second solution process including a status variable update step*** of ***reading*** said design variable vector and said status variable vector stored

in a second storage unit, ***updating*** said status variable vector, and ***storing*** the updated status variable vector into said second storage unit, wherein said second evaluation function at said second solution process ***comprises a norm of residual vector***, and said ***status variable vector is not initialized upon start of said second solution process***.

Patnaik discloses a method of (optimality criteria method, page 1 column 1 paragraph 2 lines 1-5), apparatus for (CometBoards, page 10 column 2 last paragraph lines 1-3), and program to be executed by an information processing apparatus (OC code, page 7 section III paragraph 1) for optimally designing a structure comprising a step of obtaining a solution of a structure optimal designing problem formulated as a dual optimization problem. Patnaik further discloses the dual optimization problem having a **first solution process** (page 9 equation 26, variable *F* defined on page 41 equation C6) and a **second solution process** (taught as the solving for displacement constraints, page 9 equation 31) to solve an optimization problem of a first and second evaluation, respectively, both of which being functional for a status variable vector and a design variable vector. Patnaik further discloses the **status variable vector being a displacement in each node** (definition of variable X from equation 31, listed on bottom left of page 40), and the **design variable vector being an existence ratio of a structural member in each element** (taught in the reference as "density", see derivation of equation 26 on page 41 equation C6, where *F* is a defined to be a design variable).

Patnaik further discloses the **first solution process including the second solution process as one step** (page 9 equation 27). Patnaik further discloses **the first solution process including a design variable update step** of **reading** the design variable vector and status variable vector stored in a first storage unit (page 6 equation 21a), **updating** the design variable vector (page 6 equation 21b), and **storing** the design variable vector into the first storage unit (page 6 column 2 second paragraph). Patnaik further teaches **the second solution process including a status variable update step,** as seen in equation 27 on page 9 of the reference. The displacement (status variable vector) vector *X* depends on the design variable vector *F*. As discussed above, the design variable vector is read from a storage unit, updated, and stored. Because *X* depends on *F* and *F* is updated, it is suggested that the status variable vector *X* is also **read** from a storage unit, **updated**, and **stored** into the storage unit. Patnaik further discloses the **second evaluation function comprising a norm of residual vector** (taught as difference, page 9 column 1 lines 2-5). Patnaik further discloses **the status variable vector not being initialized upon the start of the second solution process** (page 7 column 2 section IIIA, taught as variables being initialized as the problem specification is being read, i.e. before the optimizer is called).

As per claims 2 and 8, Patnaik discloses an **optimality criteria method** being performed at the first solution process (page 7 section IIIB first paragraph).

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. Claims 3 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Patnaik as applied to claims 1, 2, 7, 8 and 13 above, in view of Lingen, "A Generalised Conjugate Residual Method for the Solution of Non-symmetric Systems of Equations with Multiple Right-hand Sides," (c) 1999 John Wiley & Sons.

As per claims 3 and 9, Patnaik does not disclose expressly a conjugate residual method, a GCR method, a GCR(k) method, an Orthomin(k) method, or a GMRES(k) method and its derivative methodbeing executed at the second solution process. Lingen discloses a method using an iterative solver for updating variables in structural design. Lingen uses the **GCR method** (page 642 first full paragraph) and its

derivative method for updating variables (page 647 first paragraph). It would have been obvious at the time to one of ordinary skill in the art of optimal structure design, at the time of the present invention to modify Patnaik's dual optimization method with Lingin's GCR method to achieve a dual optimizer that uses the iterative GCR method to update the status variable. The motivation for doing so would have been to use an iterative solver as opposed to a direct solver in order to use less memory (Lingen page 641 last paragraph).

11. Claims 4-6, 10-12 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Patnaik as applied to claims 1, 2, 7, 8 and 13 above, in view of Dickinson et al., "Preconditioned Conjugate Gradient Methods for Three Dimensional Linear Elasticity, from the Department of Computer Science at the University of Waterloo, published 2/9/1993.

Claims 4, 10 and 14 are directed to a method for, an information processing apparatus for, and program to be executed by an information processing apparatus for, respectively, optimally designing a structure comprising a step of obtaining a solution of a structure optimal designing problem, formulated as a dual optimization problem having ***a first solution process*** to solve an optimization problem of a first evaluation functional for ***a status variable vector and a design variable vector*** and a ***second solution process*** to solve an optimization problem of a second

evaluation functional ***for said status variable vector and said design variable vector***, wherein when ***said status variable vector is a displacement in each node, and said design variable vector is an existence ratio of a structural member in each element***, said ***first solution process including said second solution process as one step***, and further including ***a design variable update step*** of ***reading*** said design variable vector and said status variable vector stored in a first storage unit, ***updating*** said design variable vector, and ***storing*** the updated design variable vector into said first storage unit, and said ***second solution process comprising a conjugate gradient method, and including a preconditioning step of executing preconditioning on a nodal force vector based on a global stiffness matrix, and a status variable update step*** of ***reading*** said design variable vector and said status variable vector stored in a second storage unit, ***updating*** said status variable vector, and ***storing*** the updated status variable vector into said second storage unit, wherein said second evaluation function at said second solution process ***comprises a norm of residual vector***, and said ***status variable vector is not initialized upon start of said second solution process***.

Patnaik discloses a method of (optimality criteria method, page 1 column 1 paragraph 2 lines 1-5), apparatus for (CometBoards, page 10 column 2 last paragraph lines 1-3), and program to be executed by an information processing apparatus (OC code, page 7 section III paragraph

1) for optimally designing a structure comprising a step of obtaining a solution of a structure optimal designing problem formulated as a dual optimization problem. Patnaik further discloses the dual optimization problem having a **first solution process** (page 9 equation 26, variable *F* defined on page 41 equation C6) and a **second solution process** (taught as the solving for displacement constraints, page 9 equation 31) to solve an optimization problem of a first and second evaluation, respectively, both of which being functional for a status variable vector and a design variable vector. Patnaik further discloses the **status variable vector being a displacement in each node** (definition of variable X from equation 31, listed on bottom left of page 40), and the **design variable vector being an existence ratio of a structural member in each element** (taught in the reference as "density", see derivation of equation 26 on page 41 equation C6, where *F* is a defined to be a design variable). Patnaik further discloses the **first solution process including the second solution process as one step** (page 9 equation 27). Patnaik further discloses **the first solution process including a design variable update step** of **reading** the design variable vector and status variable vector stored in a first storage unit (page 6 equation 21a), **updating** the design variable vector (page 6 equation 21b), and **storing** the design variable vector into the first storage unit (page 6 column 2 second paragraph). Patnaik further teaches **the second solution process including a status variable update step,** as seen in equation 27 on page

9 of the reference. The displacement (status variable vector) vector *X* depends on the design variable vector *F*. As discussed above, the design variable vector is read from a storage unit, updated, and stored. Because *X* depends on *F* and *F* is updated, it is suggested that the status variable vector *X* is also **read** from a storage unit, **updated**, and **stored** into the storage unit. Patnaik further discloses the **second evaluation function comprising a norm of residual vector** (taught as difference, page 9 column 1 lines 2-5). Patnaik further discloses **the status variable vector not being initialized upon the start of the second solution process** (page 7 column 2 section IIIA, taught as variables being initialized as the problem specification is being read, i.e. before the optimizer is called).

Patnaik does not disclose expressly the second solution process comprising a conjugate gradient method, and including a preconditioning step of executing preconditioning on a nodal force vector based on a global stiffness matrix. Dickinson discloses a method for solving a three-dimensional (i.e.- structural) problem using a process comprising a **conjugate gradient method** (abstract of reference), using displacement vectors (i.e.- the claimed status variables). Dickinson's conjugate gradient method also includes a **preconditioning step that executes preconditioning on a nodal force vector** (page 4 fourth paragraph) **based on a global stiffness matrix** (page 6 first full paragraph lines 11-15).

It would have been obvious to one of ordinary skill in the art of optimal structure design, at the time of the present invention, to modify Patnaik's dual optimization method with Dickinson's preconditioned conjugate gradient method to achieve a dual optimizer that uses a preconditioned conjugate gradient method in order to update the status (displacement) variable vector claimed in the invention. The motivation for doing so would have been to decrease performance cost by using an iterative method such as a preconditioned conjugate gradient method as opposed to a direct solver (Dickinson page 23 last paragraph).

As per claims 5 and 11, Patnaik discloses an **optimality criteria method** being performed at the first solution process (page 7 section IIIB first paragraph).

As per claims 6 and 12, Dickinson discloses the **preconditioning being performed by setting a component in a row or column of the nodal force vector to 0 when a diagonal component in the corresponding row or column of the global stiffness matrix becomes 0** (page 7 equations 12, 15, in that the component vector values depend on the stiffness matrix values).

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

i. Japanese Patent Publication no. 2001-134628, filed by Aida et al. on 5/18/2001, is directed to a dual optimization method for a structure including a design variable update method.

ii. "Structural Optimization Using a New Local Approximation Method," by Chickermane et al., published in the International Journal for Numerical Methods in Engineering in 1996, discloses a structural optimization method that uses a Generalized Convex Approximation algorithm for design variable updating.

iii. "Recent Developments in Topology Design of Materials and Mechanisms," by Bendsoe, published in ESAIM Proceedings Vol. 11, 2002, discusses the use of topology design.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kimberly Thornewell whose telephone number is (571)272-6543. The examiner can normally be reached on 8am-4:30pm M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamini Shah can be reached on (571)272-2279.

The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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